SCIENCE 10

TEACHER MANUAL

CLASSROOM
ASSESSMENT
MATERIALS

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Alberta
EDUCATION

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The Classroom Assessment Materials

Background

The Classroom Assessment Materials Project (CAMP) was launched in 1994 in response to Alberta Education's goal of establishing and effectively communicating clear learning outcomes and high standards for each area of learning. As well, the project is a response to teachers' ongoing requests for high-quality assessment materials to use in their classrooms. CAMP also addresses the need for a common understanding of provincial standards that is frequently expressed by parents, teachers, school administrators, and other public spokespeople.

Although Alberta teachers and Alberta Education developed the Classroom Assessment Materials for teachers to use in Alberta's schools, educators from other provinces and countries have indicated that these materials have considerable potential for their jurisdictions.

Development

Alberta Education staff have worked closely with teachers from all over Alberta to design and develop the Classroom Assessment materials. A project advisory committee with representation from key education organizations, including the Alberta Teachers' Association, provided essential advice and direction for the overall shape and philosophy of the project. Teachers have contributed in numerous and invaluable ways. They have:

- selected resource material and data bases
- developed questions and activities
- validated materials
- offered their time and classrooms for field testing and pilot testing
- provided advice about administration and manageability
- served on revision committees
- provided advice regarding the articulation of expectations from grade to grade/course to course and across subjects
- written and revised scoring criteria
- selected examples of students' work and written commentaries about them
- confirmed that the standards represented and expressed in the final materials are appropriately demanding, faithful to *Program of Studies* expectations, and clearly expressed or illustrated.

Without the dedication and professionalism of Alberta teachers, this project would not have happened.

Purpose of the Classroom Assessment Materials

The Classroom Assessment Materials are summative assessment packages. They are designed to be used by classroom teachers to assess students' achievement of the learning outcomes specified in the *Program of Studies* relative to clearly stated standards.

The assessment activities in the CAMP materials are designed to be administrated in a classroom setting at times that suit the needs of the teacher and her or his students. The materials are not suitable for any other assessment purpose (e.g., diagnostic assessment, pre-instruction assessment, evaluation of instructional practice, system-wide assessment, program evaluation, teacher evaluation), and therefore they may not be used for any purpose imposed by any authority external to the classroom.

Contents of Each Set of Classroom Assessment Materials

Each set of Classroom Materials contains three "documents":

- a *Teacher Manual* with complete information about the assessment activities, their relation to the *Program of Studies*, the weighting of assessment components, statements of standards, and administration instructions including scoring criteria and details for calculating students' marks
- complete *Student Materials*—all of the information, tests, and booklets that students will need for each component
- *Examples of Students' Responses* that show actual student work in relationship to the scoring criteria, along with explanatory commentary

For each grade, subject, and/or course, there are several assessment components that work together to provide teachers and parents with a broadly based portrait of a student's achievement of the expectations for students learning at the end of that grade/course.

Each set of assessment materials includes a variety of activities—selected-response questions, short written-answer questions, extended writing activities, performance tasks such as lab experiments, problem-solving activities, and oral presentations. All activities are designed to interest students and to be of direct and practical use for teachers. All are directly related to learning outcomes from the *Program of Studies*.

Effective Use of the Classroom Assessment Materials

Teachers may use the Classroom Assessment Materials whenever they want to find out about a student's performance in relation to set standards for the end of that grade/subject/course. The materials were developed with the following questions in mind:

- What knowledge, skills, and attitudes should a student have firmly in place before he or she moves to the next grade or course?
- How well should students completing the learning outcomes for a particular grade/subject/course do what is expected of them?
- What does acceptable work for a grade/subject/course look like?
- What does excellent work for a grade/subject/course look like?

Teachers may administer the components in whatever order suits their classroom assessment needs; however, the components are designed to be used together. Only the complete set of assessment activities will provide a portrait of how well a student has met the standards for that grade/subject/course. Teachers may photocopy the materials as their needs require.

Acknowledgements

This project has come to be because of the remarkable cooperation of school jurisdictions, hundreds of teachers and principals, and thousands of students. From everyone on the project teams—thank you.

The project teams also wish to thank the following organizations without whose consultation and advice the project would not have progressed:

Alberta Teachers' Association
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CAMP Project Leaders
Frank Horvath and Elana Scraba

CAMP Subject Coordinators

English Language Arts	Elana Scraba
Mathematics	Hugh Sanders
Science	Greg Hall, Greg Thomas, Bernie Galbraith
Social Studies	Doug Burns

Contents

In addition to this *Teacher Manual*, the Science 10 Classroom Assessment Materials include a complete set of *Student Materials* and *Examples of Students' Responses*.

The Science 10 Classroom Assessment

- ***Overview of the Assessment***
- ***Components of the Assessment***
- ***Blueprint of the Assessment***
- ***Description of Standards***

Overview of the Assessment

Component	Time Required	Marks	Weighting (%)
End-of-Course Exam	2 hours	68	70
Performance Assessment	3 hours	32	30

Components of the Assessment

End-of-Course Exam

This component of the assessment consists of three kinds of items. Each item is placed within a context that connects the information to realistic and everyday situations. There are 43 **selected-response** (multiple-choice) items, worth one mark each. Students must choose one of the four responses that are presented and enter them on a scan sheet. There are five **numerical-response** items, worth one mark each. Students must generate an answer that is expressed numerically and enter it according to the instructions given by their teacher. Finally, there are four **written-response** questions worth 4, 5, or 6 marks each. These require the student to generate an extended answer to a question, using proper conventions of communication.

Performance Assessment

This component of the assessment consists of four **hands-on activities** that require the manipulation of equipment and/or materials in a science laboratory setting. A practical, realistic context is provided for each activity. Each task is worth 8 marks and is scored using holistic scoring criteria. This assessment requires that teachers observe students in their performance of the tasks.

Blueprint of the Assessment

Curriculum Specifications for Knowledge		**Assessment Strategies**		
		Prescriptive Response (60%)	**Open-Ended Response (40%)**	
General Learner Expectations *Students will be able to:*	**Emphasis**	**Selected and Numerical Response (50%)**	**Written Response (20%)**	**Performance Tasks (30%)**
1. describe how energy and matter are transferred in all physical and biogeochemical changes; and identify energy transfers in the hydrologic cycle, photosynthesis and cellular respiration, the combustion of fuels, and energy conversion devices	**15–20%**	÷	÷	÷
2. explain that energy and matter exist in many forms and are transferred, moved, and conserved in and among physical, chemical, and biological systems	**35–40%**	÷	÷	÷
3. apply the law of energy conservation to energy transfer, calculating efficiency; and identify ways of conserving energy	**30–35%**	÷	÷	÷
4. use the relationships among force, distance, work, energy, and time to describe how energy is measured; and compare the functioning of common energy conversion devices	**15–20%**	÷	÷	÷
5. apply the principle of conservation of matter to calculations and investigations into chemical changes that produce substances useful to society and/or may have unpredictable effects on the environment	**10–15%**	÷	÷	÷
6. describe atoms, ions, and molecules; and investigate the chemical and physical properties of common elements and compounds; and apply the classification system to identify elements, ionic and molecular compounds, and common household substances	**20–25%**	÷	÷	÷

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Curriculum Specifications for Skills		Assessment Strategies		
		Prescriptive Response (60%)		Open-Ended Response (40%)
General Learner Expectations *Students will be able to:*	**Emphasis**	**Selected and Numerical Response (50%)**	**Written Response (20%)**	**Performance Tasks (30%)**
1. perform investigations, tasks, and procedures designed by themselves and others, which have few simple variables, yield direct evidence, and require empirically-based explanations	**30–35%**			÷
2. collect, verify, and organize data into tables, graphs, and diagrams designed by themselves and others, and put into written form; and describe findings or relationships, using scientific vocabulary, notation, and concepts	**20–25%**	÷	÷	÷
3. plot data that yield straight-line graphs; and use appropriate SI notation, fundamental and derived units and formulas; and determine slopes of, and areas under, straight-line graphs	**15–20%**			÷
4. use mathematical language of ratio and proportion, and simple equations, to solve numerical problems; and use chemical equations and nomenclature to communicate scientific ideas, relationships, and concepts	**10–15%**	÷	÷	÷

Continued

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Continued

Curriculum Specifications for Science, Technology, and Society Connections		Assessment Strategies		
		Prescriptive Response (60%)		Open-Ended Response (40%)
General Learner Expectations *Students will be able to:*	**Emphasis**	**Selected and Numerical Response (50%)**	**Written Response (20%)**	**Performance Tasks (30%)**
1. list, for a given instance, appropriate and relevant examples that relate direct scientific evidence to a theory; and describe the limitations of science and technology in answering all questions and solving all problems	**10–15%**	÷	÷	
2. list, for a given instance, appropriate and relevant examples of technological solutions to practical problems; and describe the functioning of technologies, using scientific principles; and relate the ways in which science and technology advance one another	**10–15%**	÷	÷	
3. identify, for a given instance, appropriate and relevant examples that show how science and technology are influenced and supported by society, and describe the responsibility of society, through science and technology, to protect the environment and use natural resources wisely	**10–15%**	÷	÷	
4. identify subject-related careers and apply the skills and knowledge acquired in Science 10 to everyday life and to related and new concepts in subsequent studies of science	**5–10%**	÷	÷	

Description of Standards

The following statements describe what students demonstrate when they have met the ***acceptable standard*** or the ***standard of excellence*** at the end of the Science 10 course. The statements represent the standards against which student achievement will be measured.

Acceptable Standard

Students who achieve the ***acceptable standard*** in Science 10 demonstrate:

Concepts

- basic understanding of the concepts in the *Program of Studies* and the ability to apply these concepts within limited contexts when interpreting the natural and designed world
- an understanding that there are several disciplinary sciences and major themes such as energy, matter, and change that are cross-disciplinary
- an ability to use basic skills and strategies in approaching problem solving and scientific inquiry
- an ability to carry out an independent or group investigation, that generally adheres to the tenets of sound scientific inquiry and follows guidelines for safe and ethical practices
- an ability to use generally correct terminology and language of science when communicating answers to assignments
- an understanding of the scientific enterprise as an attempt to better understand the natural world, of how technology assists in that process and is also an outcome of scientific understanding
- an interest in science and an appreciation for the roles of science and technology in shaping our society

Knowledge

Students who perform at the ***acceptable standard*** demonstrate basic understanding of the concepts and cross-disciplinary themes outlined in the *Program of Studies,* and recognize and identify specific instances in which these apply. For example, when demonstrating an understanding of energy and matter transfer, they trace, in general, their movement within a living system such as a plant, through a natural physical system such as the weather, or within a simple device such as a toaster. When demonstrating understanding of basic life processes, for instance, these students name and describe the structure of simple cells, and explain the overall functioning of cells in terms of matter and energy exchange with the environment. When applying their understanding of energy and matter transformations, these students classify, name, and describe various types of energy and matter, and describe conservation of matter in chemical changes and energy efficiency. Students who perform at the acceptable level demonstrate an understanding of forces by measuring and describing forces and calculating the work done on an object. They infrequently transfer knowledge from one unit of study to another.

Continued

Continued

Skills

Students who perform at the ***acceptable standard*** demonstrate an ability to carry out investigations designed for them to obtain scientific evidence. They identify trends and relationships in data and provide simple explanations that incorporate scientific concepts to explain their findings, analyze data graphically for simple relationships, and solve one-step numerical problems using algorithms and/or equations provided for them. Students who perform at an ***acceptable standard*** organize their data and information, which may be incomplete, and communicate generally, using the correct conventions of language arts and science.

Science, Technology, and Society Connections

Students who perform at the ***acceptable standard*** demonstrate an understanding of scientific inquiry. For example, they provide an example of how a scientific theory is developed from evidence, and differentiate between scientific and non-scientific statements. They demonstrate an understanding of the differences between science and technology. For example, these students describe the functioning of a simple device on the basis of scientific principles. Students who perform at an ***acceptable standard*** demonstrate an understanding that science and technology develop within a societal context. For example, they recognize the impact of the introduction of a new technology, list a few positive and negative effects, and suggest solutions to simple environmental problems.

Attitudes

Students who perform at the ***acceptable standard*** demonstrate an interest in science. For example, they suggest questions for scientific inquiry, and they read and interpret simple science-based writings. These students generally demonstrate positive attitudes toward scientific inquiry and their work. For example, when carrying out research, investigations, and assignments, these students demonstrate perseverance, respect for evidence, and willingness to work with others to provide solutions to problems.

Continued

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Standard of Excellence

Students who perform at the ***standard of excellence*** in Science 10 demonstrate:

Concepts

- an in-depth understanding of the concepts in the *Program of Studies* and the ability to apply these concepts in a wide variety of contexts in interpreting the natural and designed world
- an understanding that there are several disciplinary sciences and major themes such as energy, matter, and change that are cross-disciplinary
- an ability to carry out an independent or group investigation that adheres to the tenets of sound scientific inquiry and follows guidelines for safe and ethical practices
- an ability to use correct terminology and language of science when communicating answers to assignments
- an ability to use a variety of skills and strategies in approaching problem solving and scientific inquiry
- an understanding of the scientific enterprise as an attempt to better understand the natural world, and of how technology assists in that process and is also an outcome of scientific understanding
- an interest in science and an appreciation for the roles of science and technology in shaping our society

Knowledge

Students who perform at the ***standard of excellence*** demonstrate understanding of the concepts and cross-disciplinary themes outlined in the *Program of Studies,* and recognize and identify specific instances in which these apply. For example, when demonstrating an understanding of energy and matter transfer they trace, in detail, their movement within a living system such as a plant, through a natural physical system such as the weather, or within a simple device such as a toaster. When demonstrating understanding of basic life processes, for instance, these students name and describe the structure of simple and more complex cells, and explain the overall functioning of cells in terms of matter and energy exchange with the environment. When applying their understanding of energy and matter transformations, these students classify, name, and describe various types of energy and matter, demonstrate that matter is conserved in chemical changes, and calculate energy efficiency. Students who perform at the ***standard of excellence*** demonstrate an understanding of forces by measuring and describing forces and calculating the work done on an object. Students at the ***standard of excellence*** frequently transfer knowledge from one unit of study to another.

Continued

Continued

Skills	Students who achieve the ***standard of excellence*** demonstrate an ability to carry out investigations they have designed themselves to obtain scientific evidence. They identify trends and relationships in data and provide explanations that incorporate scientific concepts to explain their findings, analyze data graphically, and solve numerical problems using algorithms and/or equations and scientific knowledge. Students who perform at the ***standard of excellence*** collect thorough data and information and organize it logically and neatly, and communicate consistently, using the correct conventions of language arts and science.
Science, Technology, and Society Connections	Students who perform at the ***standard of excellence*** demonstrate an understanding of scientific inquiry. For example, they provide an example of how a scientific theory developed from evidence, and differentiate between and critically analyze scientific and non-scientific statements. They demonstrate an understanding of the differences between science and technology. For example, these students describe the functioning of a device on the basis of scientific principles. Students at the ***standard of excellence*** demonstrate an understanding that science and technology develop within a societal context. For example, they identify the impact of the introduction of a new technology, describe numerous positive and negative effects, and suggest creative solutions to environmental problems.
Attitudes	Students who perform at the ***standard of excellence*** demonstrate an interest in science. For example, they suggest questions for scientific inquiry, and they read and interpret science-based writings. These students demonstrate positive attitudes toward scientific inquiry and their work. For example, when carrying out research, investigations, and assignments, these students demonstrate creativity, perseverance, respect for evidence and precision, and willingness to work with others to provide solutions to problems.

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Administering and Scoring the Assessment Components

- ***End-of-Course Exam***
- ***Performance Assessment***

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End-of-Course Exam

Administration

1. It will take students approximately 2 hours to complete the selected and written response component of the test.

2. Ideally, the assessment should be completed in a single session. If this is not possible, the exam can be administered over two class periods.

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Item Analysis and Key

Item	Key	K/S/STS	GLE nos. *
SR 1	D	K	1
2	D	K	1
3	B	K	1
4	B	K	1
5	B	K	2
6	A	S	2
7	D	S	2
8	C	K	2
9	B	STS	2, 3
10	B	S	1
11	C	S	1
12	D	K	2
13	D	K	2
14	A	STS	2
15	D	K	2
16	D	K	2
17	A	S	2
18	D	K	2
19	C	K	2
20	B	K	6
21	C	S	4
22	B	STS	3
23	C	K	6
24	B	K	6

Continued

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Continued

Item	Key	K/S/STS*	GLE nos.**
25	D	K	1, 6
26	C	K	5, 6
27	A	K	5
28	C	K	2
29	B	K	5
30	B	K	6
31	C	K	6
32	B	S	1
33	C	STS	3
34	D	K	3
35	B	K	3
36	D	K	3
37	A	K	3
38	A	K	4
39	C	K	4
40	D	K	3
41	B	K	3
42	C	K	3
43	D	STS	3
NR 1	109	S	4
2	4231	S	1
3	1342	S	2
4	0.96	S	4
5	609	S	4
WR 1 (4 marks)	refer to P.15	K, S	2, 4
2 (5 marks)	refer to P.16	S, STS	2, 2
3 (5 marks)	refer to P.17	K, S, STS	1, 4, 3
4 (6 marks)	refer to P.18	K, S	1, 4, 4

*K=Knowledge
S=Skills
STS=Science, Technology, and Society Connections

**See Blueprint of the Assessment, p. 4–6, for descriptions of General Learner Expectations.

Keys and Scoring Criteria for Written Responses

Question 1

1.a. The overall equation for the process of photosynthesis in the plant is:
Light Energy + $6CO_{2(g)}$ + $6H_2O_{(l)}$ Æ $C_6H_{12}O_{6(s)}$ + $6O_{2(g)}$

1.b. The control experiment should be different from the set up depending on what you wanted to find out. If you wanted to know if light made a difference, you would set up another experimental bottle in the dark. If you wanted to know if the snail made a difference, you would set up another bottle without the snail. If you wanted to know if the plant made a difference, you would set up another bottle without the plant. If you wanted to know if lake water made a difference, you would set up another bottle with distilled water. If you wanted to know if temperature made a difference, you would set up one bottle in a cold place, etc.

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Holistic Scoring Criteria for Written Response 1

Score	Scoring Criteria
4	The question is completely answered, demonstrating an excellent understanding of scientific experimental design and the role of a control. Scientific conventions of communication are consistently and correctly followed in writing chemical reaction equations. A clear understanding of the relationship between a chemical process and a chemical equation is demonstrated.
3	The question is answered, demonstrating an understanding of scientific experimental design and the role of a control. Scientific conventions of communication are followed, except for minor errors. An understanding of the relationship between a chemical process and a chemical equation is demonstrated.
2	The question is partially answered, demonstrating a basic understanding of scientific experimental design and the role of a control. Scientific conventions of communication are generally followed in writing chemical reaction equations. A basic understanding of the relationship between a chemical process and a chemical equation is demonstrated.
1	The question is only partially answered. Scientific conventions of communication are attempted, but are either incomplete or contain errors. An understanding of the relationship between a chemical process and a chemical equation is not demonstrated.
0	The response does not address the question at an appropriate level for a Science 10 course.

Question 2

2.a. Calculations chart for three cubes

Cube	Side (cm)	Volume (cm^3)	Surface Area (cm^2)	Surface area-to-volume ratio cm^2/cm^3
A	10.0	1000	600	0.600
B	5.0	125	150	1.2
C	2.0	8	24	3.0

2.b. Cube C would have the most efficient matter exchange with the environment because of the large surface-to-volume ratio.

2.c. Technologies applicable to a large surface area-to-volume ratio generally consist of a large surface comprising many cells that are folded or constructed so that a maximum of the interior is exposed to the outside environment. Examples include car radiators, the pads inside humidifiers, cooling towers, portable heaters, etc.

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Holistic Scoring Criteria for Written Response 2

Score	Scoring Criteria
4	The provided data are accurately and completely analyzed; the mathematical calculations are correct. Results are displayed, using scientific conventions of communication. The interpretations are correct. An appropriate technological application of the principle is thoroughly described.
3	The provided data are completely analyzed; the mathematical calculations are mostly correct. Results are displayed, using scientific conventions of communication. The interpretations are mostly correct. An appropriate technological application of the principle is identified, but not thoroughly described.
2	The provided data are analyzed. Mathematical calculations are partially correct. Results are displayed, generally using scientific conventions of communication. An interpretation is attempted, but may not be correct. The technological application of the principle that is described may not be entirely appropriate.
1	The provided data are incompletely analyzed; the mathematical calculations contain errors. An interpretation is not attempted. The technological application identified does not illustrate the principle.
0	The response does not address the question at an appropriate level for a Science 10 course.

Question 3

3.a. Sulphur dioxide is produced by the reaction of sulphur with oxygen according to one of these equations:

$S_{(s)} + O_{2(g)}$ Æ $SO_{2(g)}$

$S_{8(s)} + 8O_{2(g)}$ Æ $8SO_{2(g)}$

3.b. While this solution reduces the pollution of air near the smokestack, it spreads the contaminated air to further sites.

3.c. Precipitation will carry the sulphur dioxide down to Earth, while winds will carry it to another location.

3.d. Some alternative solutions to this problem are to
- use low sulphur fuels
- remove sulphur from the fuel before burning it
- filter sulphur dioxide from the smokestack exhausts
- encourage energy conservation

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Holistic Scoring Criteria for Written Response 3

Score	Scoring Criteria
4	Scientific conventions of communication are consistently and correctly followed in writing chemical reaction equations. Scientific principles are used in thoroughly explaining the impact of human actions on the environment. Relevant societal, technological, and scientific concepts are used in suggesting a solution to the problem.
3	Scientific conventions of communication are followed in writing chemical reaction equations; however, there may be a small error. Scientific principles are used in explaining the impact of human actions on the environment. Relevant societal, technological, and scientific concepts are used in suggesting a solution to the problem.
2	Scientific conventions of communication are generally followed in writing chemical reaction equations. Scientific principles are used in partially explaining the impact of human actions on the environment. Relevant societal, technological, and scientific concepts may be used in suggesting a solution to the problem.
1	Scientific conventions of communication are attempted in writing chemical reaction equations, but there are major errors and omissions. Scientific principles are mentioned, but they may not be relevant to the questions. The solution to the problem is inappropriate or lacking.
0	The response does not address the question at an appropriate level for a Science 10 course.

Question 4

4.a. The strongest updrafts would occur midday to late in the day, when thermal energy rises from the heated Earth.

4.b. The updrafts the eagles glide on are the result of thermal energy transfer, which can be traced back to the Sun.

4.c. The velocity of the eagle is 64 km/h.

v	=	D*d*/D*t*
	=	700 km/11h
	=	63.636 km/h

4.d. The distance travelled by the eagle is 7.5 ¥ 10^3 m or 7.5 km.

D*d*	=	*v*D*t*
	=	150 km/h ¥1000 m/km ¥ 3.0 min ¥ 1 h/60 min
	=	7500 m

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Holistic Scoring Criteria for Written Response 4

Score	Scoring Criteria
4	Scientific principles are used to explain observed phenomena thoroughly and correctly. Data are accurately and completely analyzed. Mathematical calculations are correct. The appropriate scientific algorithms, formulas, SI units, and significant digits are consistently used in showing all work.
3	Scientific principles are used to correctly explain observed phenomena. Data are accurately analyzed. Mathematical calculations are correct. The appropriate scientific algorithms, formulas, SI units, and significant digits are used in showing all work.
2	Scientific principles are used to explain observed phenomena. Data are analyzed. Mathematical calculations are generally correct with only minor errors. The appropriate scientific algorithms, formulas, SI units, and significant digits are not consistently used in showing all work.
1	Scientific principles are used inappropriately or are lacking. Data may be analyzed. Mathematical calculations are incorrect. The appropriate scientific algorithms, formulas, SI units, and significant digits are used inappropriately or not at all.
0	The response does not address the question at an appropriate level for a Science 10 course.

Performance Assessment

Advance Preparation

1. It will take students approximately 3 hours to complete the four tasks in the performance assessment component of the test.

2. Note the amount of time suggested for each task. If it is not possible to complete the tasks in a single session, the performance assessment can be administered over two or more class periods.

3. Review the scoring criteria and make sure that you share the criteria with your students.

4. Read through each task, taking note of the materials and equipment required and any special instructions regarding the preparation of materials. A complete list of all the material and equipment required is found later in this Teacher Manual.

5. You may wish to arrange the tasks as "stations" around the room so that students performing the same task are not sitting right next to each other. If possible, arrange several duplicates of each task so that students do not have to wait before moving on to a task they have not done yet.

Administration

1. Students should be provided with the test booklet and all the materials they need to complete each task.

2. Students are expected to work independently on the tasks.

3. Students should write their names on their test booklets and any other materials they hand in, and write their answers in their booklets.

4. It may be necessary to remind students to move on to another task after a certain amount of time.

Scoring

1. Holistic scoring guides are provided for each performance task. Read them carefully, as they provide guidance on how to assign marks.

2. Each task is to be scored according to two of the three sets of criteria, either "planning and designing," "performing and recording," or "analyzing and applying." Teachers may wish to score each task on all three scoring criteria if it suits the individual situation.

3. Most tasks are to be scored according to the criteria for "performing and recording." This will require observation by the teacher of the method and techniques the student is using to complete the task. Guidelines for making observations are included in this Teacher Manual.

4. Each performance assessment task is assigned 8 marks with a total of 32 marks allotted for the entire assessment. If all three scoring criteria are used, each task would be assigned 12 marks for a total of 48 marks for the entire assessment.

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Holistic Scoring Criteria for *Planning and Designing*

Score	Scoring Criteria
4	The problem is clearly stated and understood, and a well thought out plan is devised. The procedure and design described are appropriate (valid, practical, and workable) for solving the problem.
3	The problem is stated and understood, and a workable plan is devised. The procedure and design described (with modification to remove errors and make up omissions) can be used to solve the problem.
2	The problem is stated and partially understood, and a plan is written. The procedure and design described are appropriate for solving only part of the problem.
1	The problem is not well understood and the plan is incomplete. The procedure and design described are inappropriate for solving the problem.
0	No attempt is made to understand the problem or develop a plan, procedure, or design for solving the problem.

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Holistic Scoring Criteria for *Performing and Recording*

Score	Scoring Criteria
4	The procedure is carried out accurately, systematically, and safely to gather complete data without any errors or omissions; materials and apparatus are used correctly and efficiently; observations and data are clearly, neatly, logically, and completely recorded, consistently using scientific conventions of communication.
3	The procedure is carried out accurately and safely to gather data that are mostly complete but may contain some errors or omissions; materials and apparatus are used correctly; observations and data are recorded neatly, using scientific conventions of communication.
2	The procedure is carried out, but the data collected are incomplete; materials and apparatus are used appropriately; observations and data are recorded clearly and neatly, but there are some errors and omissions, and scientific conventions of communication are not always consistently followed.
1	The procedure is carried out, but the data obtained are incomplete and inaccurate; observations and data recorded contain many errors and omissions.
0	The procedure is attempted, but data obtained cannot be used to solve the problem.

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Holistic Scoring Criteria for *Analyzing and Applying*

Score	Scoring Criteria
4	Data and observations are accurately and completely analyzed; appropriate mathematical calculations and graphical analysis are correctly performed; the result is correct, and there is a low experimental error; a complete and accurate interpretation and conclusion are reached.
3	Data and observations are completely analyzed; appropriate mathematical calculations and graphical analysis are performed, but contain some errors; the result contains inaccuracies, and there may be a high experimental error; the interpretations and conclusions are mostly correct.
2	Data and observations are analyzed; mathematical calculations and graphical analyses are performed, but are only partially correct; the result contains inaccuracies in relation to the data obtained; the interpretations and conclusions are only partially supported by the data.
1	Data and observations analysis are incomplete or inaccurate; mathematical calculations and graphical analysis are either not attempted or are incorrect; the conclusions reached are unsupported.
0	No analysis is performed, and no conclusion is reached.

Key for Performance Task 1

Evidence

Sample Evidence:

initial mass of candle	87.6 g
final mass of candle	85.2 g
volume of water	200 mL
final temperature of water	40.8∞C
initial temperature of water	9.5∞C

Analysis

temperature change of water	31.3˚C
mass of candle wax burned	2.4 g

1. *Q* = *mc*D*t*
= 200 g ¥ 4.19 J/g ˚C ¥ 31.3 ˚C
= 26229.4 J or 26.2 kJ

The energy absorbed in heating the water is 26.2 kJ.

2. 47.2 kJ/g ¥ 2.4 g = 113 kJ

The energy given off by the burning candle is 113 kJ.

3. Efficiency of heating water with the burning candle:

% efficiency = $\frac{\text{output}}{\text{input}}$ ¥ 100 = $\frac{26.2\text{ kJ}}{113\text{ kJ}}$ ¥ 100 = 23.2%

Application

Answers should suggest ways of cutting down heat loss to the surroundings; e.g., placing the candle close to the can, using a shield to direct heat at the can, or covering the can to prevent heat loss.

Assessment Guidelines

Curriculum Fit

General Learner Expectations*

Students will be able to:
- apply the law of energy conservation to energy transfer, calculating efficiency; and identify ways of conserving energy
- perform investigations, tasks, and procedures, designed by others, that have a few, simple variables, yield direct evidence, and require empirically-based explanations

* For a complete listing of GLEs applicable to performance tasks in this assessment, see the Blueprint for the Assessment on p. 4–6.

Specific Learner Expectations

Unit 1, Major Concept 3 states that students will:
- calculate the thermal energy involved when a measured mass of water undergoes a measured temperature change
- calculate any variable in the equation, $Q = mc\Delta t$, given the other three variables

Unit 4, Major Concept 4 states that students will:
- define efficiency as a measure of the useful work compared to the total energy put into an energy conversion process
- conduct an investigation in which the efficiency of common technological devices used to heat a specific amount of water is quantified and evaluated

Time Required: 40–45 minutes

Observation Guidelines

1. The balance is used correctly, without the need for help.

2. The measuring cylinder is used to measure accurately and without spillage.

3. The water is heated in a safe manner:
   - apparatus is set up in a stable manner
   - combustibles are kept away from open flame
   - care is taken in handling hot objects or surfaces.

4. Care is taken in measuring the temperature of the water:
   - the water is stirred before temperature is taken
   - the thermometer is not touched to the bottom or sides of the container.

Key for Performance Task 2

Procedure

1. Label 3 slides A, B, and C.

2. Break the piece of onion and pull the two halves gently apart.

3. Place some onion epidermis on each slide. Add a drop or two of methylene blue to each onion epidermis (if using white onion). Use tissue to remove excess solution.

4. Prepare 3 wet mounts of the thin layer of onion epidermis, using 2 drops of salt solution A, B, or C.

5. Remove any excess solution by placing a piece of tissue next to the edge of the cover slip.

6. Make the necessary adjustments to observe the wet mounts under high power.

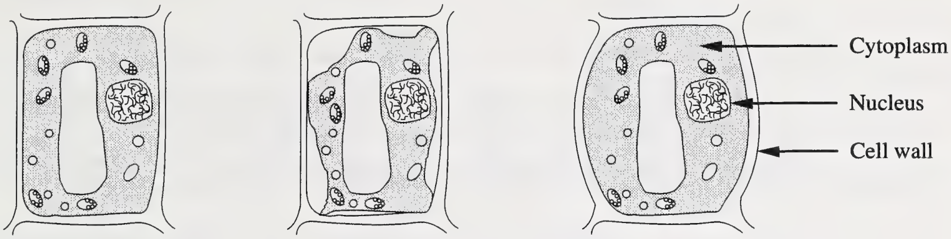
Evidence

Suggested Data Table

Solution	Observations of Cell Characteristics
A	cells show no change
B	cells show evidence of cytoplasm water loss and pull away from the cell wall
C	cells show evidence of swelling and loss of the "brick-like" appearance

Cell Shape Sketch

Solution A **Solution B** **Solution C**



0.9% $NaCl_{(aq)}$ 5% $NaCl_{(aq)}$ Distilled water

Analysis

Solution	Identification
A	0.9% salt solution
B	5% salt solution
C	distilled water

Synthesis

Plant cell cytoplasm is approximately 98 to 99% water. If the plant cells are exposed to distilled water (hypotonic solution C), water will enter the cell cytoplasm by osmosis, causing swelling. Conversely, if cells are exposed to solutions containing less water (hypertonic solution B), water will leave the cytoplasm by osmosis, causing the cytoplasm to "ball up". Isotonic solution A (99% water) will have no effect on the cells because it has the same solute concentration as the cell cytoplasm.

Assessment Guidelines

Curriculum Fit

General Learner Expectations*

Students will be able to:
- explain that energy and matter exist in many forms and are transferred, moved and conserved in and among physical, chemical and biological systems
- perform investigations, tasks and procedures, designed by others, that have a few, simple variables, yield direct evidence, and require empirically-based explanations

* For a complete listing of GLEs applicable to performance tasks in this assessment, see the Blueprint for the Assessment on p. 4–6.

Specific Learner Expectations

Unit 2, Major Concept 1 states that students will:
- prepare plant and animal material for microscopic examination, using stains and observing the materials

Unit 2, Major Concept 3 states that students will:
- describe how materials diffuse across a cell membrane in terms of concentration gradients
- describe how the semipermeable nature of the cell membrane allows the process of osmosis
- perform an experiment to demonstrate the phenomena of plasmolysis and deplasmolysis in plant cells; e.g., staminal hairs or aquatic leaf cells, and describe the observed events in terms of tonicity of cells and solutions

Time Required: 35–45 minutes

Observation Guidelines

1. The accepted procedure for preparing a wet mount is used:
   - the onion epidermis is laid flat on the slide
   - reasonable volumes of solutions are added (1 to 3 drops)
   - excess solution is removed
   - the coverslip is carefully dropped into place.

2. Proper technique for adjusting the microscope is used:
   - the low power objective is brought into place first
   - only the fine adjustment is used for high power.

Key for Performance Task 3

Procedure

1. Use a graduated cylinder to measure 10.0 mL of water in a polystyrene cup.
2. Record the initial temperature of the water.
3. Weigh out 1.0 g of ammonium nitrate crystals onto a small watch glass.
4. Add the crystals to the water in the polystyrene cup.
5. Stir the mixture with a plastic spoon to dissolve the crystals as quickly as possible.
6. Read and record the lowest temperature shown on the thermometer.
7. Repeat steps 1 to 6, using a different mass (between 2.0 and 10.0 g) of ammonium nitrate with 10.0 mL of water each time.

Evidence

Suggested Data Table

Test	Mass of ammonium nitrate (g)	Initial temperature (∞C)	Final temperature (∞C)
1	1.0	20.2	15.2
2	2.0	21.0	13.4
3	4.0	20.0	2.6
4	5.0	20.6	4.5
5	7.0	20.5	–0.5
6	8.0	21.3	–4.2

Analysis

1.

Test	Change in Temperature (°C)
1	5.0
2	7.6
3	17.4
4	16.1
5	21.0
6	22.2

2. The greatest temperature change occurred with 8.0 g of ammonium nitrate and 10.0 mL of water.

Application

From these results, students might recommend 6.0 g or more of ammonium nitrate with 10.0 mL of water as the ideal amounts of reactants to use for a cold pack, as this results in the greatest temperature change. The limitations are the amount that will dissolve and a convenient size for the cold pack. As well, too large a temperature decrease might freeze flesh if in contact for too long.

The design of the cold pack should take into consideration:

- convenient size for placing on an injury
- leakproof and durable material to hold contents, separately
- a method for separating the water and the ammonium nitrate when the pack is being stored, yet which allows them to readily mix when needed (inner and outer pouch, in which the inner pouch can be broken by squeezing)

Assessment Guidelines

Curriculum Fit

General Learner Expectations*

Students will be able to:
- apply the principle of conservation of matter to calculations and investigations into chemical changes that produce substances useful to society and/or may have unpredictable effects on the environment
- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

* For a complete listing of GLEs applicable to performance tasks in this assessment, see the Blueprint for the Assessment on p. 4–6.

Specific Learner Expectations

Unit 3, Major Concept 4 states that students will:
- perform experiments that illustrate chemical changes, including endothermic and exothermic chemical changes

Time required: 40 minutes

Observation Guidelines

1. An appropriate procedure is used:
   - the graduated cylinder, balance, and thermometer are used correctly and accurately
   - appropriate amounts of ammonium nitrate are chosen for each trial after the first; e.g., 2.0 g, 3.5 g, 5.0 g, etc.
   - inconclusive tests are repeated.

2. Care is taken so that spillage is minimal and there is proper disposal of used materials.

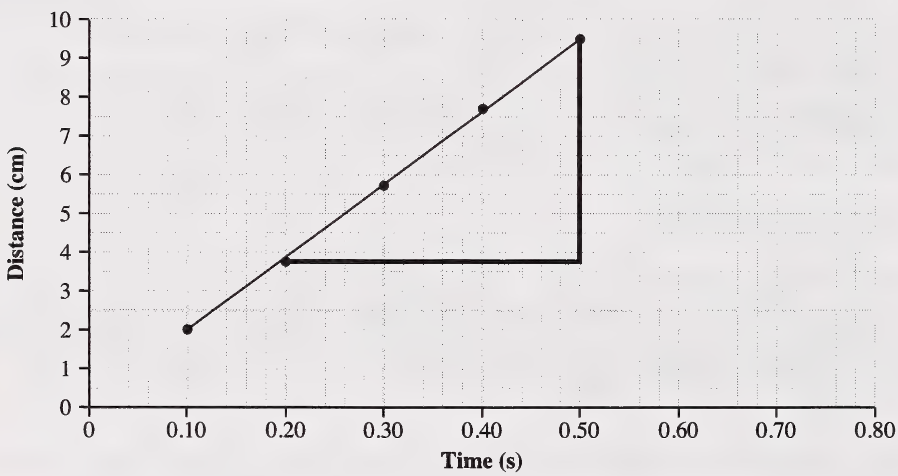
Key for Performance Task 4

Evidence

Suggested Data Table

Interval	Time (s)	Cumulative Distance (cm)
1	0.10	1.9
2	0.20	3.8
3	0.30	5.7
4	0.40	7.6
5	0.50	9.5

Distance–Time Graph



The slope of the graph is equal to the speed.

$$
\begin{aligned}
\text{Slope} &= \frac{Dd}{Dt} \\
&= \frac{x_2 - y_1}{x_2 - x_1} \\
&= \frac{(9.5 - 3.8)\ \text{cm}}{(0.50 - 0.20)\ \text{s}} \\
&= \frac{5.7\ \text{cm}}{0.30\ \text{s}} \\
&= 19.0\ \text{cm/s}
\end{aligned}
$$

The speed is 19 cm/s.

Assessment Guidelines

Curriculum Fit

General Learner Expectations*

Students will be able to:
- use the relationships among force, distance, work, energy, and time to describe how energy is measured; and compare the functioning of common energy conversion devices
- perform investigations, tasks, and procedures, designed by themselves and others, that have a few, simple variables, yield direct evidence, and require empirically based explanations

* For a complete listing of GLEs applicable to performance tasks in this assessment, see the Blueprint for the Assessment on p. 4–6.

Specific Learner Expectations

Unit 4, Major Concept 1 states that students will:
- perform an experiment to determine the relationship among distance, speed, and time for uniform motion
- calculate the slope of a distance–time graph to determine the speed

Time Required: 30–40 minutes

Observation Guidelines

1. Measurements are done carefully and accurately:
   - the first clear marking is chosen
   - an interior gradation on the ruler is chosen to line up with the first mark on the ticker tape.

2. Proper graphing techniques are used to analyze the evidence.

3. A best-fit line is drawn.

List of Materials and Equipment

Apparatus

thermometers
balances
ring stands
microscopes

Glassware

graduated cylinders (10 mL and 100 mL)
slides and cover slips
watch glasses

Chemicals

candles
0.9% $NaCl_{(aq)}$
5.0% $NaCl_{(aq)}$
distilled water
methylene blue
$NH_4NO_{3(s)}$

Miscellaneous

small tin cans and lids
stirring rods
forceps
scalpels
lens tissue paper
white or purple onions
polystyrene cups
plastic spoons
metric ruler

Calculating and Recording Student Achievement

• Standards for Overall Performance on the Assessment
• Class Record Form

Standards for Overall Performance on the Assessment

Scoring criteria for each component of the assessment are provided in the teacher instructions. Standards for overall performance on the assessment are as follows:

Not Yet at Acceptable Standard	Acceptable Standard	Standard of Excellence
0%–49%	50%–79%	80%–100%

Standards for the assessment were established and validated using the scoring criteria outlined for each task. If the tasks are scored using different criteria or used for purposes other than assessing achievement at the end of Science 10, these standards may not be appropriate.

Adjustments can be made to administrative procedures to enable special needs students to respond. Use your professional judgement when making these adjustments to ensure that the standards still apply.

Class Record Form

Student Name	End-of-Course Exam			Performance Tasks							Total	*Standard
		(A)	(B)	Maximum Student Score					(C)	(D)		
	Total from End-of-Course Exam (68)	Total from End-of-Course Exam as %	Weighting factor of 70% A × .70	Task 1 Heating Water Efficiently (8)	Task 2 Determining Salt Concentration (8)	Task 3 Designing a Cold Pack (8)	Task 4 Analyzing Uniform Motion (8)	Total from Performance Assessment (32)	Total from Performance Assessment as %	Weighting factor of 30% C × .30	Add columns (B) and (D) (100%)	

*The standard for this assessment package is as follows:

Not Yet at Acceptable Standard	Acceptable Standard	Standard of Excellence
0%–49% **(NS)**	50%–79% **(AC)**	80%–100% **(EX)**

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